University of Nottingham
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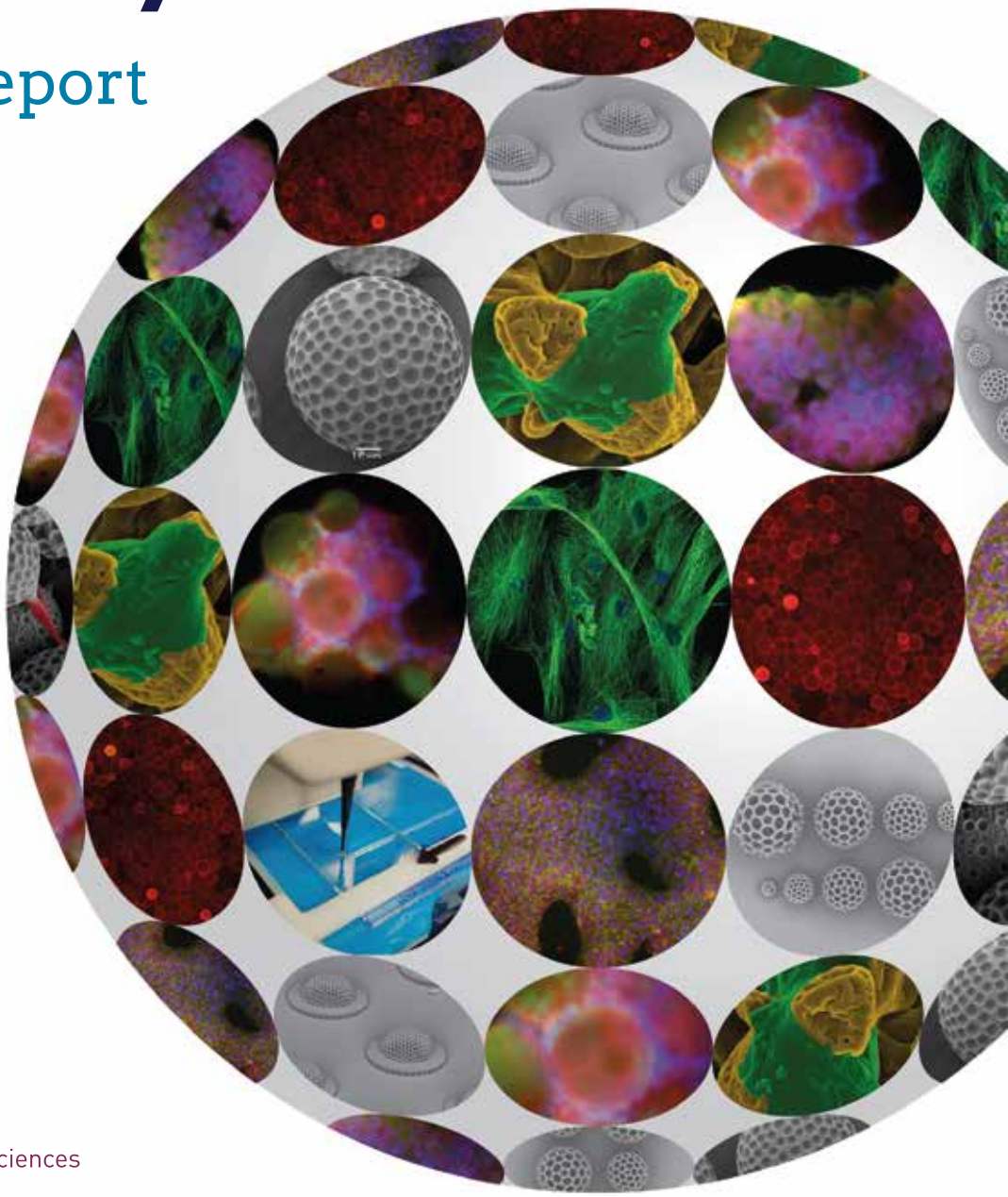
Biomaterials Discovery

EPSRC Programme Grant in

Next Generation Biomaterials Discovery

Annual Report 2016-2017



EPSRC
Engineering and Physical Sciences Research Council

Contents

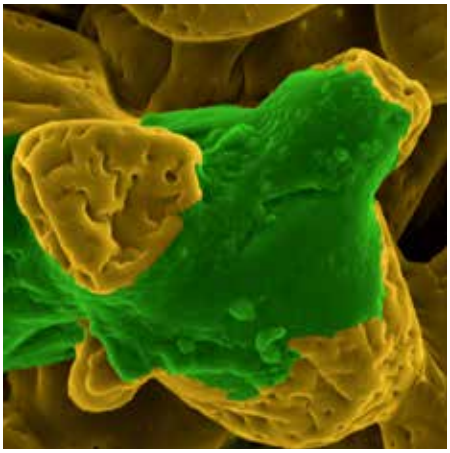
Biomaterials Discovery

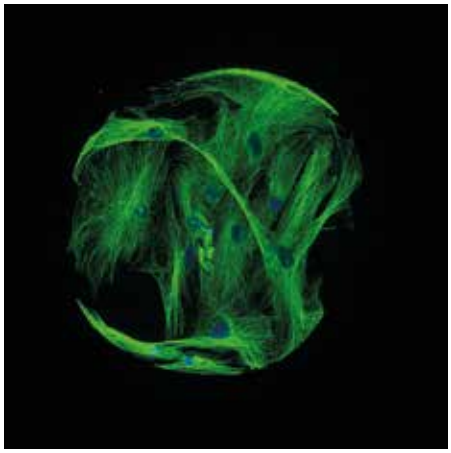
Vision

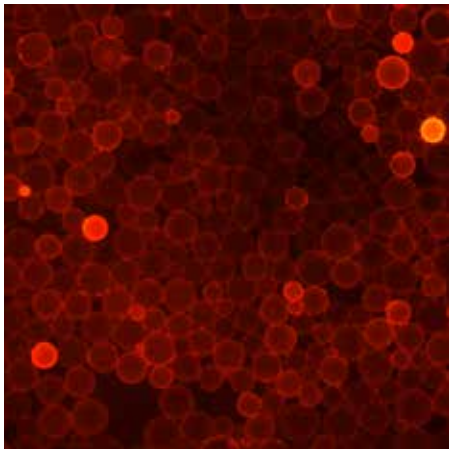
"It is a great pleasure to be able to introduce the results of the enormous amount of hard work that has been put in by the dedicated group of postdoctoral researchers and academics that constitute the core of this Engineering and Physical Sciences Research Council (EPSRC) Programme Grant in Next Generation Biomaterials Discovery.

The Programme Grant aims to generate completely new families of materials which can instruct biological responses; ranging from bacterial attachment and biofilm formation on medical devices, to cardiovascular cell maturation from stem cells for chip-based drug toxicity screening. Materials discovery in three dimensions (3D) will allow us to move beyond the existing limited range of licensed biomaterials and bioresorbable polymeric drug and cell delivery agents, to bespoke materials identified for specific drug delivery, regenerative medicine and medical device needs".

Prof Morgan Alexander,
Principal Investigator





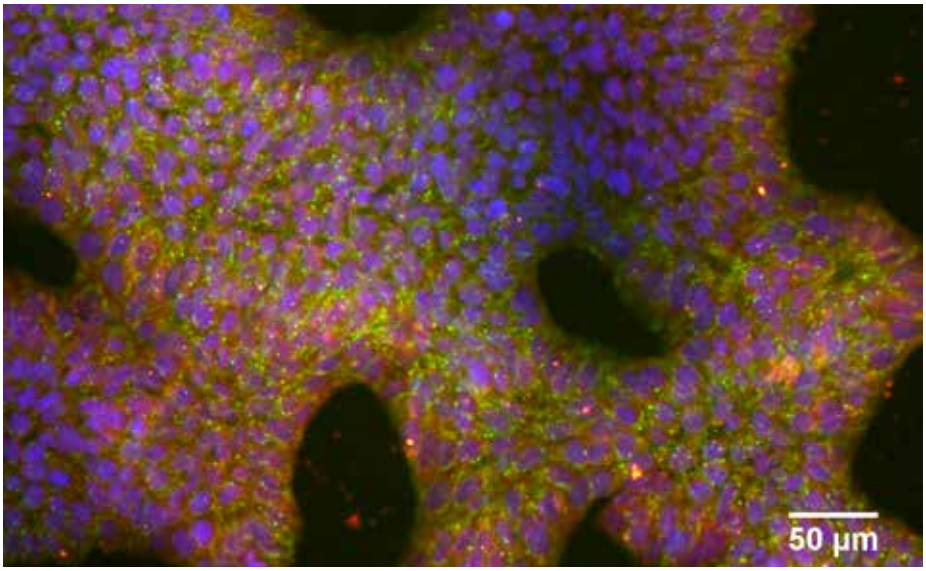


The Programme Grant was launched in 2015 with the goal of identifying new biomaterials. The project is based around screening large and diverse polymer libraries to identify bio-instructive materials for medical devices, stem cell manufacture, cell delivery and targeted drug delivery. Reducing medical device-associated infections is a key element in the fight against antimicrobial resistance, a global challenge recognized as a priority by the UN, the WHO and the UK government, and predicted to rival cancer in human and financial cost by 2050 if left unchecked.

- The next generation of bio-instructive materials will be able to recruit and modulate the function of the immune cells in our bodies using appropriate surface chemistry, architecture and topography. This will result in implants which integrate better and have reduced failure rates and indwelling devices such as catheters which resist infection. To identify these materials, we are moving from screening flat polymer libraries to topographically textured libraries, particles and porous bodies. These hit materials will be developed into lead candidate materials which can be progressed to the exploitation stage by licensing, partnering and spin out. The market value of the biomaterials sector is estimated to reach 130bn USD by 2020[a].

- Stem cell derived cardiomyocyte maturation for chip-based toxicological screens is under development, using 3D tissue architectures with novel biomaterials. Using mature cardiomyocytes derived from stem cells drug compound screening for cardiotoxicity will be improved by eliminating harmful drug candidates early in the discovery process before costly clinical trials and reducing animal use in line with the three Rs (Replace, Reduce, Refine). In 2008 in the UK 475,290 animal procedures were carried out for drug safety assessment and toxicity testing[b]. Estimates suggest that if an assay improved predictability of toxicity in humans by 1%, the pharmaceutical industry would save up to $100 million[c].

- Nanoparticulates for drug delivery are inherently 3D materials, but their function *in vitro* and *in vivo* is critically dependent on detailed structure and architecture across all dimensions. In the Programme Grant we are developing methods for rapid generation of 3D biomaterial architectures, using multiple chemical functions to allow attachment of diverse therapeutic molecules, imaging agents and biological targeting ligands. A key aspect of these novel biomaterials is their programmed disassembly in 3D, such that the delivery systems can be tuned for optimal biodistribution and end-fate. Application foci are therapeutics for cancer and anti-microbial resistance.



Images from top to bottom, left to right: 1) Scanning Electron Microscopy of stem cells on boulder-shaped biodegradable polymer microparticles. 2) Stained human mesenchymal stem cells attaching to a polymer microarray spot. 3) Fluorescent Microscopy of polymer microparticles. 4) Induced Pluripotent Stem Cells on TCP.

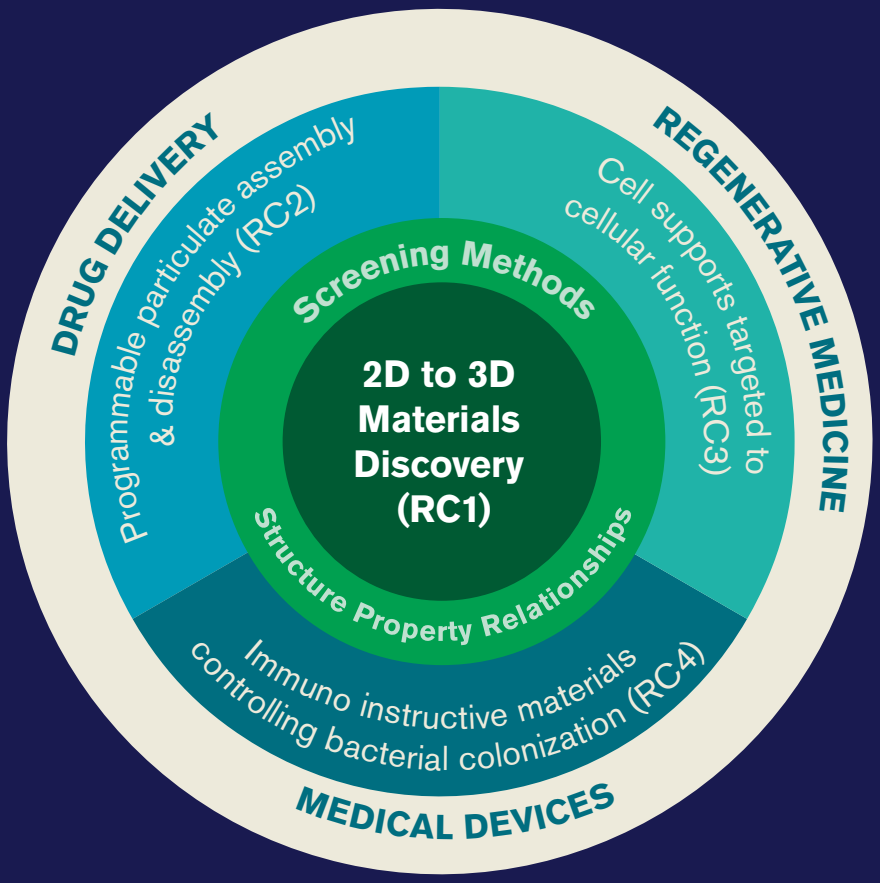
a http://www.marketsandmarkets.com/PressReleases/global-biomaterials.asp

b Holmes AM, Creton S, Chapman K. 2010. Working in partnership to advance the 3Rs in toxicity testing. Toxicology 267: 14– 9.

c Rajamohan D, Matsa E, Kalra S, Crutchley J, Patel A, George V, Denning C. 2012. Current status of drug screening and disease modelling in human pluripotent stem cells. BioEssays 35: 281-298.

Research

Research Overview

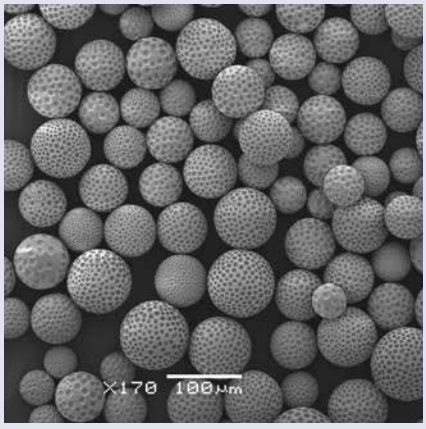


Four Research Challenges (RC):

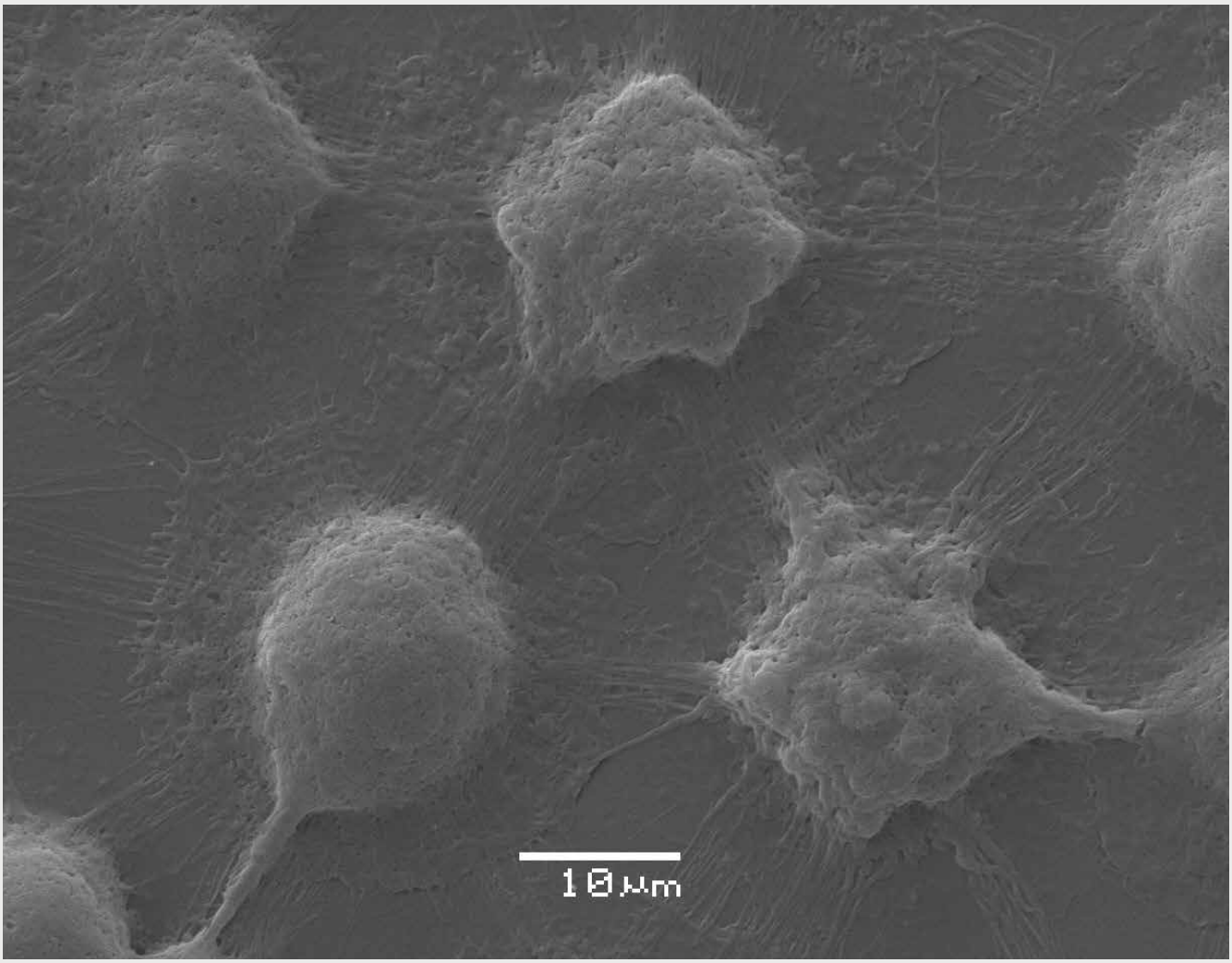
1. Moving from two-dimensions (2D) to 3D materials discovery methods.
2. Systems-based advanced drug delivery.
3. Advanced materials for 3D stem cell differentiation and regenerative medicine.
4. Advanced materials for medical devices.

Half way through the five years of the Programme Grant we are well set up, including having established new library production methods, and are now in a position where examples of 2.5 and 3D material control over cell phenotype are being demonstrated:

- The ChemoTopo Chip for simultaneous screening of chemistry and topography is in production and cell screening is revealing the relative contributions of topographical guidance control of cell shape and polymer chemistry on mesenchymal stem cells and naïve macrophages.
- Particle libraries of varying chemistries are being created using surfactant monomers (surfmers) to control stem cell response.



Microparticles with a golf-ball topography.



Macrophages on PLA.

- A neural network derived model has been used to describe the bacterial attachment of three pathogens to a large library of 2D polymer spots. The modelling methodologies are moving on to encompass 2.5D topo features to help us navigate these large data sets.
- Synthetic routes have been established for 3D assembly of polymeric nanoparticles.
- Using methodologies established in year 1, microparticles with well-controlled and defined topographies have been obtained, named 'golf ball-like' and 'boulder-like' microparticles, in addition to microparticles with a smooth surface. A method of forming 2.5D discs of these microparticles using heat sintering was established during year 2.
- The 'CellOPTIQ' platform and associated methodologies are now in place at the University of Nottingham and a KCNJ2-T2A-NanoLuc® reporter cell line has been created which is required to detect the maturation state of human induced pluripotent stem cell derived cardiomyocytes (hiPSC-CMs).
- Large-scale screening of the Topochip and ChemoTopo Chip has been successfully carried out using intracellular cytokine detection for macrophage phenotype and potential 'hits' identified. Initial work on the 3D culture of macrophages has indicated promising results on the effect of microparticle surface topography on macrophage phenotype.
- A method to assess bacterial attachment on the Topochip has been established and large differences in fluorescence associated to different micropatterns were observed. This is indicative of differential bacterial attachment on different topographies which is now being confirmed and modelled.

Research Challenge 1:
Moving from 2D to 3D materials discovery methods

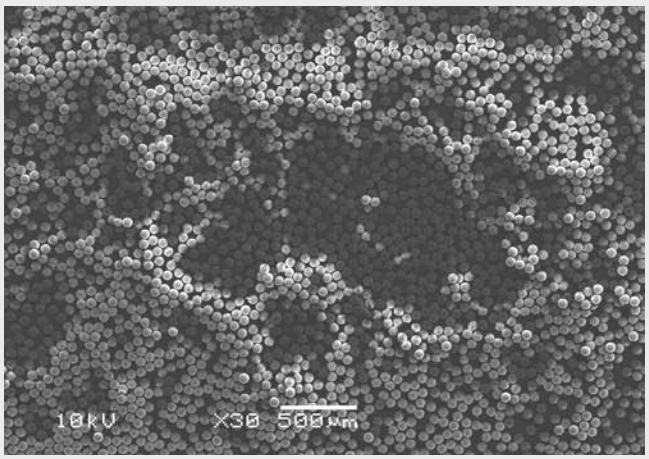
"In this section of the project we are developing new methods to create material libraries for screening with 3D architectures, including particles and topographically patterned materials. Computational methods to take screening data and develop structure-property relationships are under development and being applied in this research challenge."
Morgan Alexander (Research Challenge 1 lead)

Achievements:

- New commercially printable monomers have been identified, acrylates custom synthesized [Dundas et al in preparation], macromers synthesized and monomers synthesized in RC2 making a total of 425 unique polymerisable units.[22]
- Initial work on surfmers has been conducted with high throughput analysis of libraries undertaken.
- A micro array cell culture method has been developed and validated in order to be able to undertake high throughput cytotoxicity measurement.[22]
- ChemoTopo Chips combining 35 topounits with 27 different chemistries have been produced and supplied to RC3 and RC4. Stem cell differentiation markers are under investigation.
- Robust data exchange procedures have been introduced between all members of the grant.
- Neural network models across multiple pathogens have successfully been constructed and their application to guiding experimentation is being rolled out.

Combinatorial Particle Libraries

Dr Simon Haas / Adam Dundas: The past year of research focused on the introduction of polymeric surfactants (surfmers), from RC2, into our microfluidic particle production apparatus. To gain control of the particulate surface chemistry, surfmers containing the chemistry of interest were synthesised in RC2 to become the chemical variant in the particulate libraries. Preparation of nanoparticles (100 – 400 nm) was done in a coaxial turbulent jet-mixer which has a large output compared to microfluidics. Polymeric nanoparticles have been produced with 19 different polymers. Going forwards the range of chemistries is being increased and a fully automated commercial flow reactor is being tested.

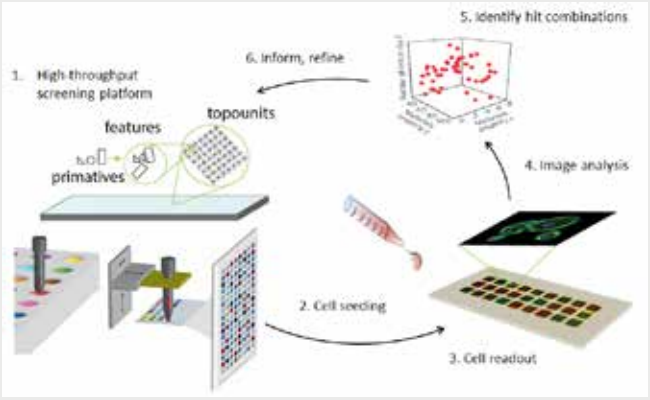


Nanoparticles produced using microfluidics.

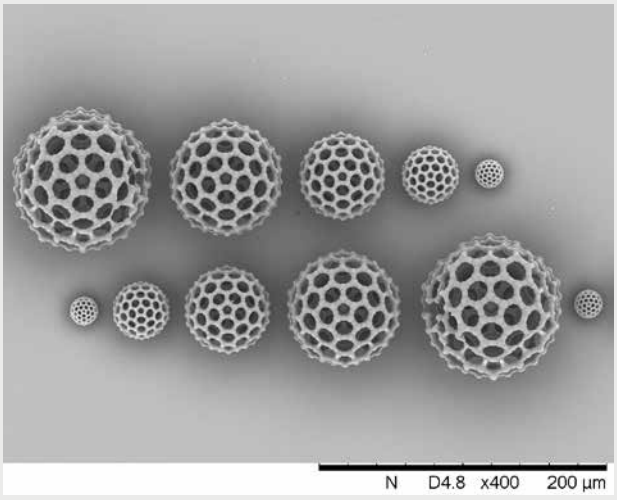
Research Challenge 1: Moving from 2D to 3D materials discovery methods

ChemoTopo Chip samples for combinatorial material - topography screening

Dr Britta Koch / Dr Laurence Burroughs: The aim is to develop and validate a sample fabrication protocol that allows interdependent assessment of material chemistry and micro-topography effects on cell responses. The pre-chip functionalisation fabrication route was validated for different monomers identifying standard methodologies that work for a large range of photo-polymerisable materials. ChemoTopo Chip samples incorporating 27 monomers selected based on chemical properties and 36 topographies have been produced. The ChemoTopo Chip screening is allowing us to comment on the influence of a range of topounits, and chemistries approaching 1000 combinations per chip. These samples are now being used for cell studies.



High Throughput Screening with the ChemoTopo Chip.



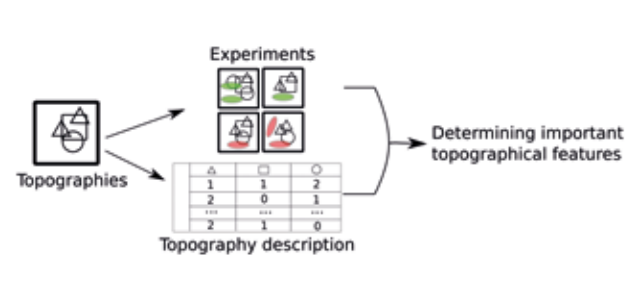
2 Photon Printed bucky balls.

Two photon polymerization

Dr Qin Hu: This is a joint post between the Additive Manufacturing Programme Grant and the Next Generation Biomaterials Discovery Programme Grant. The aim is to develop a high throughput assessment protocol for materials suitable for 2PP, which will then be extended to create 3D chemo-archi-chips.

Determining Biomaterial Design Rules

Dr Paulius Mikulskis: Models of multiple pathogens have been constructed using neural networks and molecular descriptors.[25] Moving modelling from 2D to 3D is predicted to enable more rapid experimental exploration of the near infinite parameter space.

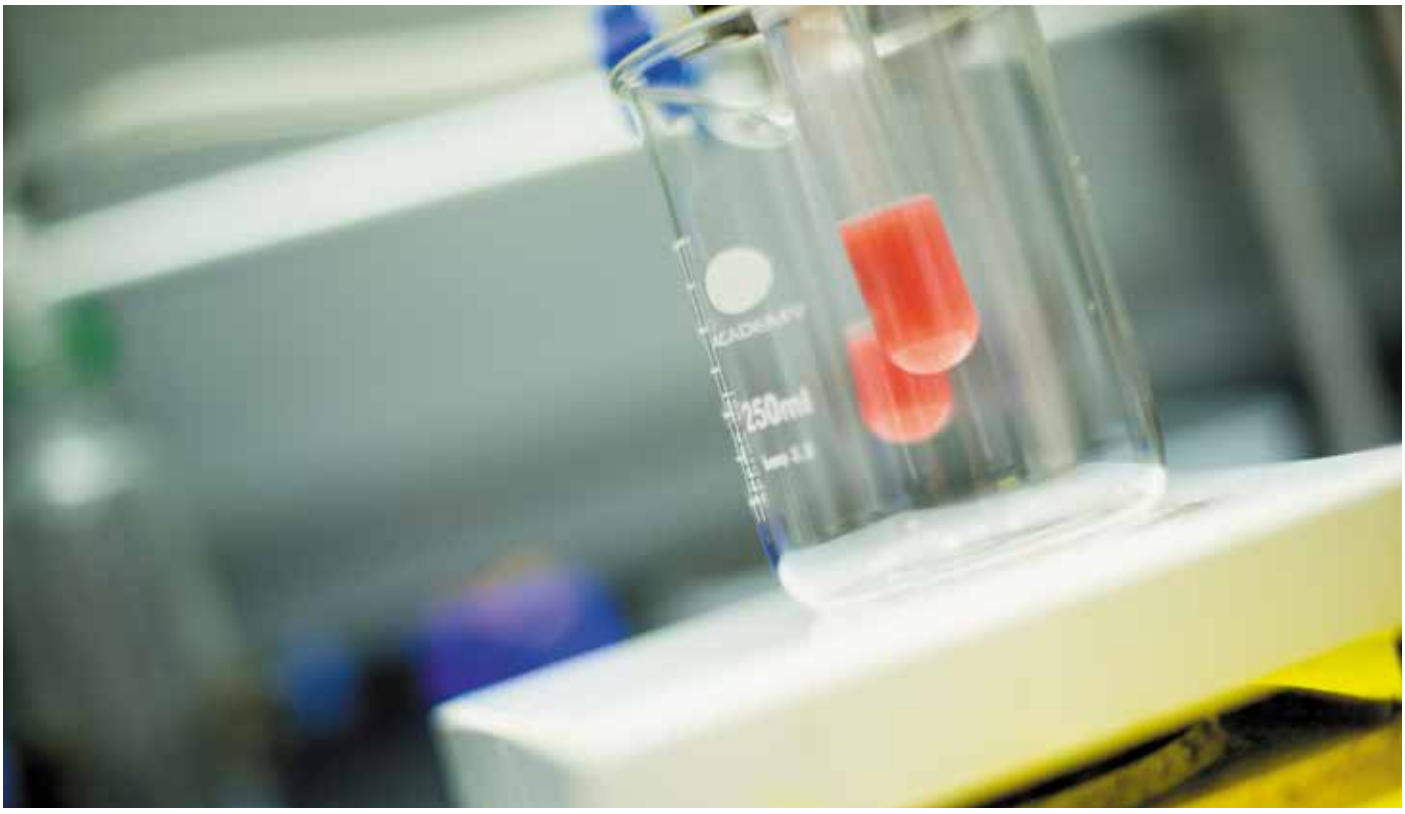


Determining important topological features for desired biological outcomes (ellipses represent cells).

Research Challenge 2:
Systems Based Advanced Drug Delivery

"We have focused on consolidation of chemistries for new self-assembling delivery vehicles, and development of new materials for bioresponsive and orthogonally controlled release of a range of actives. The applications scope of the theme remains the refinement of targeting and delivery for complex anti-cancer therapeutics, and is also addressing innovative antimicrobials, including anti-virulence agents in dynamic controlled matrices for new anti-resistance therapies."

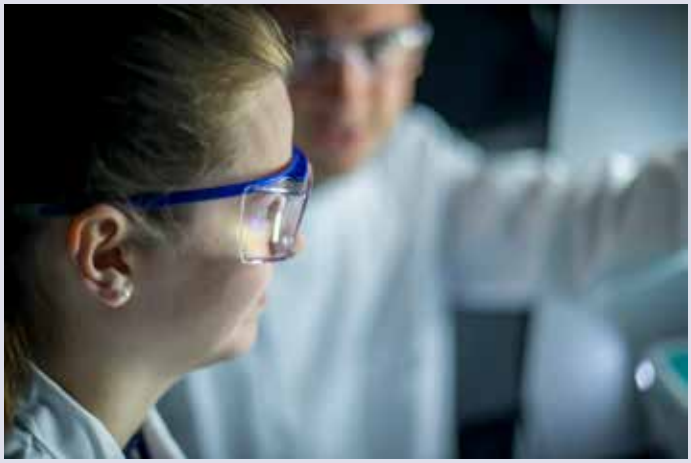
Cameron Alexander
(Research Challenge 2 lead)



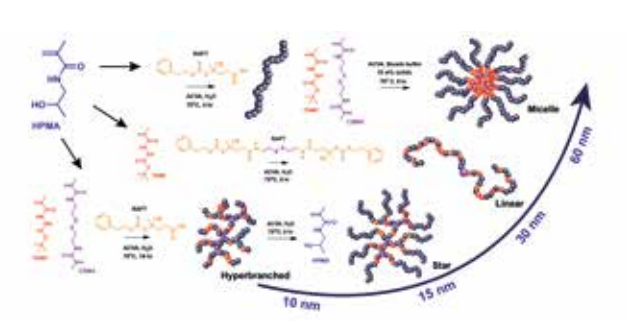
RC2: Systems Based Advanced Drug Delivery

Achievements:

- The first paper from RC2 – a route to new Passerini polymers with versatile chemistries for multiple functionalities and architectures - has been published in the leading polymer journal ACS Macro Letters.
- Libraries of polymers with varied architectures (hyperbranched, star, micellar) and defined dimensions in 3D (5-20 nm) have been synthesised and characterised.
- Polymers without conjugated or encapsulated drugs have been tested in preliminary biodistribution studies and the pHPMA series show reduced hepatic uptake than comparator PEG-based polymers
- Drug-loaded polymers have been shown to deliver successfully the current standard-of-care drugs doxorubicin and paclitaxel to MDA-MB-231 triple negative breast cancer cells *in vitro*.
- Passerini-type polymers designed for ultra-high drug loading through main chain conjugation and with self-immolative triggers have been prepared and characterised.
- Multiple alginate derivative with clickable linkers, 2-photon cross-linking or degradation sites have been prepared and characterised.
- Bioreductive chemistries have been successfully encoded into pHPMA, Passerinin and alginate polymers for triggered release of cytotoxic, cytostatic and Quorum Sensing inhibition drugs.



RC2: Systems Based Advanced Drug Delivery



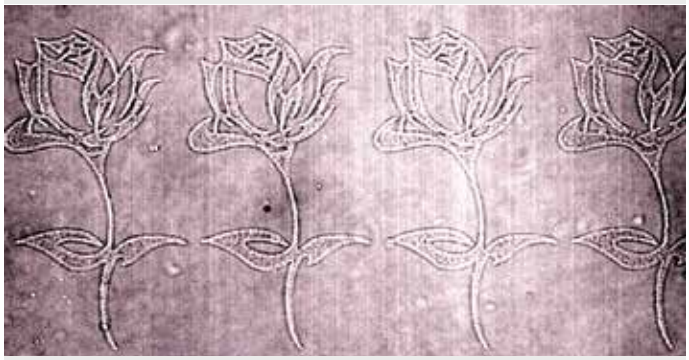
Parallel synthetic routes using Reversible Addition Fragmentation Chain Transfer Polymerisation (RAFT).

Development of synthesis methods for achieving various polymer architectures and of *in vitro* and *in vivo* assays for evaluation of polymer performance

Dr Amanda Pearce: Synthetic strategies featuring the same combinations of monomers and small molecules have been implemented to produce linear, hyperbranched, star and micelle structures from Hydroxypropyl methacrylamide, featuring drug-loading and disulfide monomers for bioreductive degradation. All polymers can be produced in parallel and have been well-characterised. Degradation studies in reducing environments are ongoing. Star and hyperbranched polymers have been successfully loaded with doxorubicin and paclitaxel. Cytotoxicity experiments have been conducted for all polymer architectures, as well as for drug-loaded hyperbranched polymers to test efficacy of drug delivery. Biodistribution studies have been completed for all polymer architectures.

Growth profile and anti-biotic resistance of different bacterial strains confined in 2-photon fabricated 3-D hydrogel structures and stimuli triggered controlled release of anti-QS and antibiotics from 3D alginate scaffolds for biofilm prevention and bacterial killing

Dr Nishant Singh: Tyramine based alginates have been designed and synthesised for 2-photon polymerisation. The polymers have a convenient azide handle for post polymerisation modifications. The modified alginates have been successfully polymerised by 2-photon laser with potential for different stiffness of the fabricated structures by varying the laser power. A library of modified alginates has been synthesised and tested for P. aeruginosa attachment. An anti-QS drug and an antibiotic have been attached to the alginate backbone. Mechanical properties of the alginates are also being tested to understand the effect on bacterial attachment.

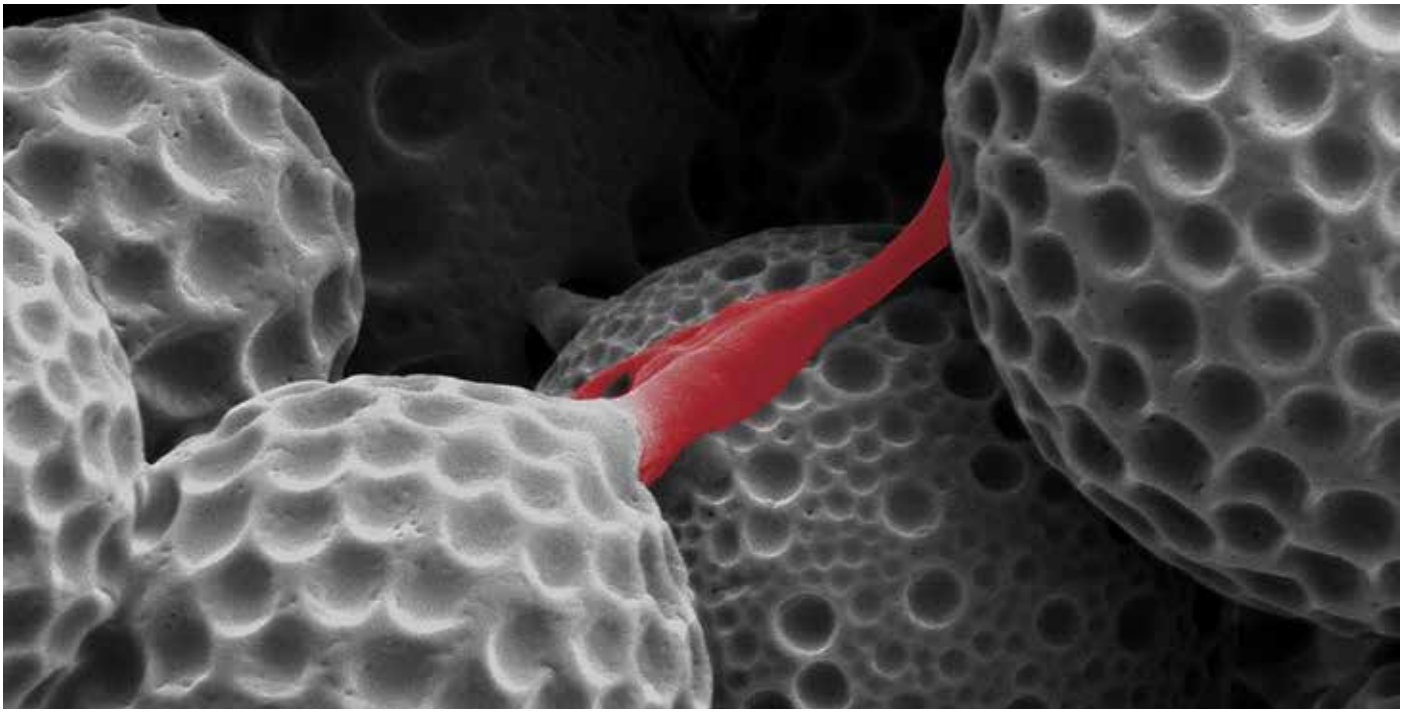


2-photon printing of a hydrogel rose.

Evaluation of active targeting of polymers in Triple Negative Breast Cancer (TNBC) model

In collaboration with Dr Kris Thurecht, Australia: All 4 polymer architectures (linear, micelle, star and hyperbranched) were synthesised to feature maleimide end-groups for attachment of the GE11 peptide for EGFR. As well, Deferoxamine was attached to the polymers for chelation of 89Zr. Imaging studies took place in January.

Research Challenge 3: Advanced Materials for 3D Stem Cell Differentiation and Regenerative Medicine



Golf-ball shaped resorbable polymer microparticles with stem cell attachment.

"We have focussed on the assessment of new material substrates to study mammalian cell-material interactions that increases the number of combinations and range of properties that can be quantitatively assessed. These materials are currently being explored in particulate 2.5D (where cells are cultured on a fixed surface of microparticles) and on ChemoTopo Chips with a view to move towards 3D culture of stem cell populations. Methodologies have been developed to assess the influence of surface topography, chemistry and elasticity on bone-marrow derived human mesenchymal stem cell differentiation to bone and induced pluripotent stem cell derived cardioprogenitor cell maturation to functional cardiomtocytes that are amenable to the high-throughput screening approach".

Felicity Rose (Research Challenge 3 lead)

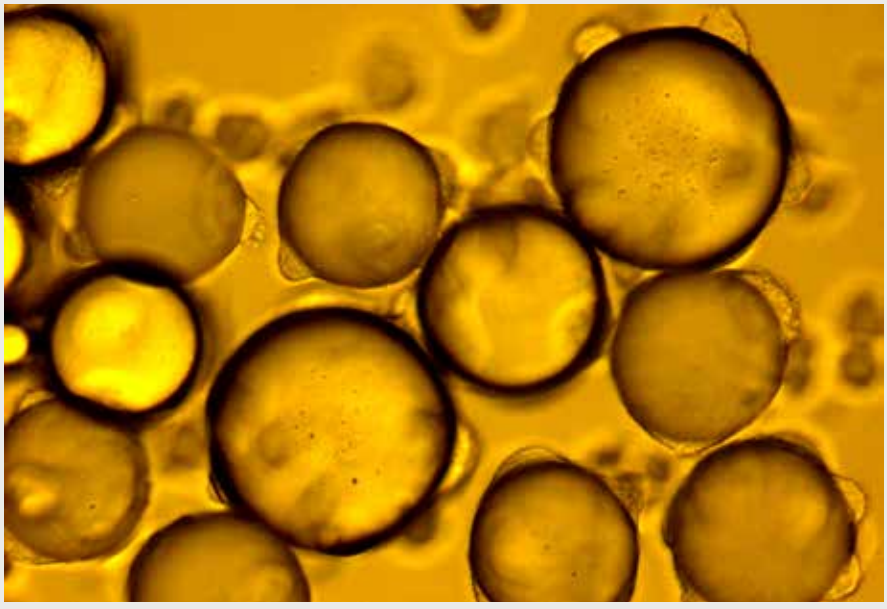
RC3: Advanced Materials for 3D Stem Cell Differentiation and Regenerative Medicine

Achievements:

- Microparticles (MPs) with well-controlled and defined topographies were obtained: 'golf ball-like', 'boulder-like' as well as smooth MPs. A method of forming 2.5D discs of these MPs using heat sintering has been established.
- An initial assessment of bone-marrow derived human mesenchymal stem cell adhesion, proliferation and morphology on 2.5D microparticle discs has been conducted.
- A 3-step process has been developed to incorporate a variety of chemistries onto the surface of the MPs including surface chemistry characterisation at each step.
- Attachment, spreading and morphology of bone-marrow derived human mesenchymal stem cells (hMSCs) from various donors was assessed on 2D polymer arrays and 'hit polymers' were identified.
- Attachment, spreading and morphology of human induced pluripotent stem cell derived cardiomyocytes (hiPSC-CMs) was assessed on 2D polymer arrays and 'hit polymers' were identified.
- The 'CellOPTIQ' platform and associated methodologies is now in place at the University of Nottingham.
- A KCNJ2-T2A-NanoLuc® reporter cell line has been created to detect the maturation state of hiPSC-CMs.

Development of a suitable approach for surface functionalisation of microparticles with 'top' chemistries and creation of MPs with well-controlled topographies

Dr Marta Alvarez: A process has been developed to incorporate a variety of chemistries onto the MPs. MPs will be further functionalised with relevant hMSC and cardiomyocyte chemical 'hits' and cell response to the different chemistries will be evaluated. MPs with different topographical features have been fabricated using a drug-induced phase separation oil-in-water emulsion technique. Two well-controlled and defined topographies were obtained, named 'golf ball-like' and 'boulder-like' MPs. These MPs were then engineered into a disc using heat sintering and termed as '2.5D' suitable to assess mammalian cell response to the induced surface topography.

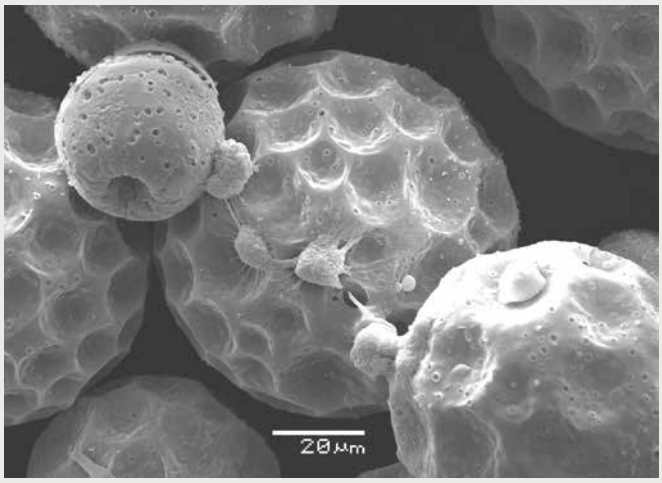


Macrophages on smooth microparticles.

RC3: Advanced Materials for 3D Stem Cell Differentiation and Regenerative Medicine

High throughput screening (HTS) for discovery of materials that influence hMSCs' attachment and fate; assessment of response of hMSCs to various topographies in 2.5D culture systems, and assessment of attachment and osteogenic capacity of MSCs on ChemoTopo Chips

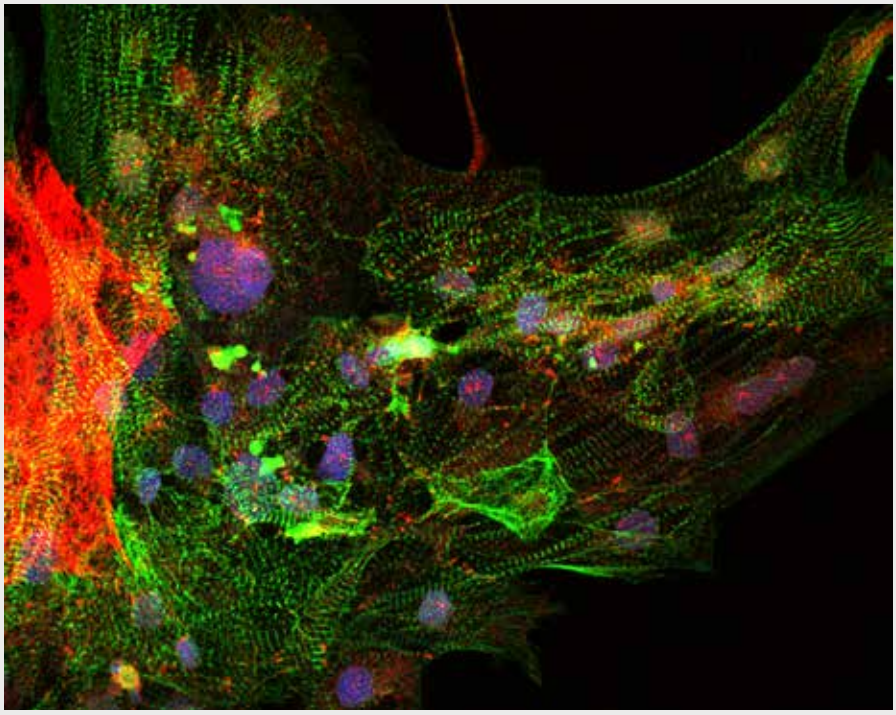
Dr Mahetab Amer: hMSC seeding on microarrays is being optimised and attachment, spreading and morphology of hMSCs from various donors was assessed on a range of polymers. Hit polymers have been identified with respect to cell attachment, spreading and morphology. Staining protocols for various osteogenesis markers are being optimised to proceed with HTS for polymers that influence osteogenic capacity. Mechanical properties of the 2.5D discs and MPs are under investigation. This will be followed by an assessment of osteogenic differentiation capacity of hMSCs on various topographies. Cells seeded on ChemoTopo Chips have been immunostained for phalloidin to investigate attachment and morphology.



Macrophages on boulder microparticles.

Developing tools to assist hPSC proliferation & cardiomyocyte maturation

Dr Karl Firth, Dr Aishah Nasir and Jordan Thorpe: Three generations of arrays have been screened to find co-polymers capable of supporting hPSC culture for 72 hours. Top hits were scaled-up to a 96-well format and need to be scaled into 6-well plates to allow a full analysis of growth rate, pluripotency, signalling and extracellular matrix properties. Two generations of hPSC-CM array screens have been performed and polymer and co-polymer hits have been identified. Cas9/CRISPR has been used to engineer a gene targeted KCNJ2-T2A-NanoLuc® line to report on hPSC-CM maturation. The "CellOPTIQ" platform has been installed and developed at the University of Nottingham and allows quantification of voltage and calcium responses by optical measure of dyes, and contraction by motion detection of pixels from videos.



HUES7 hPSC-cardiomyocytes. a-Actinin (Green), GRK5 (Red).

Research Challenge 4:
Advanced Materials for Medical Devices

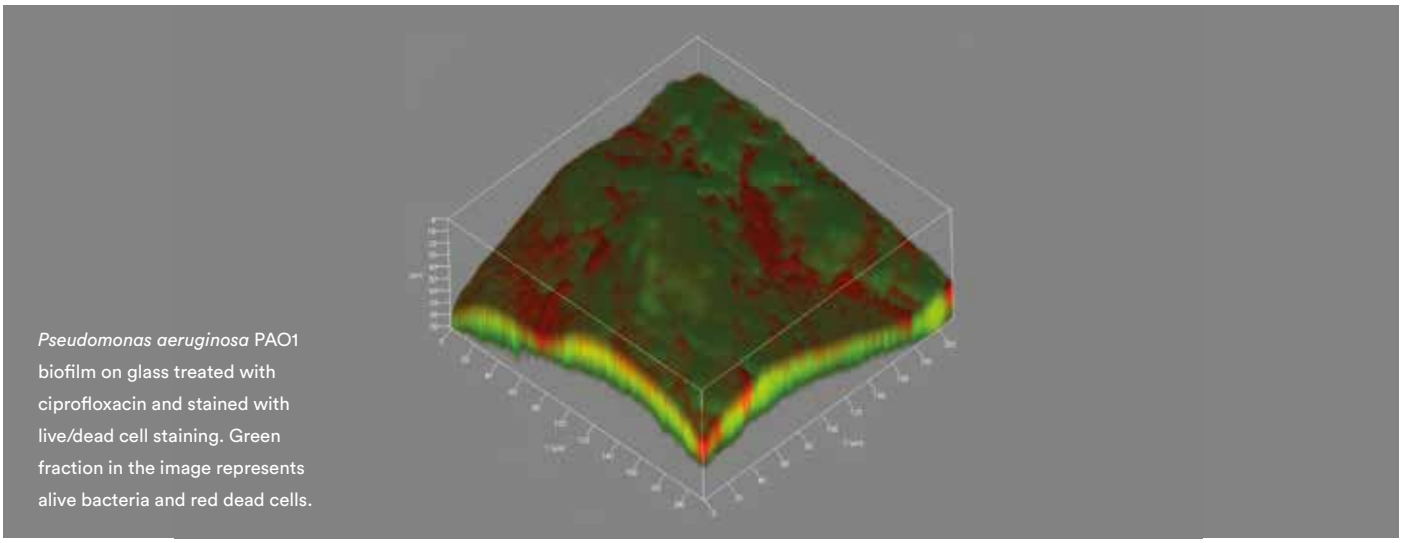
Achievements:

- Large-scale screening of the Topochip (2,176 topographies) and ChemoTopo Chip using intracellular cytokine detection (IL0 for M2 and TNFa for M1) for macrophage phenotype has been successfully carried out and potential 'hits' identified. The focus is now on testing several blood donors to establish the robustness on these approaches and data reproducibility. Also, initial work on the 3D culture of macrophages using PLA microparticles with smooth and textured surface topographies has indicated promising results on the effect of microparticle surface topography on macrophage phenotype.
- A method to assess bacterial attachment on the Topochip has been established. Large differences in fluorescence associated to different micropatterns have been observed. This is indicative of differential bacterial attachment on different topographies.

"In this section of the project we are engaging in the fight against antibiotic resistance by identifying next generation biomaterials for medical devices that prevent medical device-associated infections. We will address the problem of device failure mediated by inflammation arising from undesirable host immune responses of the body to foreign materials".

Amir Ghaemmaghami (Research Challenge 4 lead)

RC4: Advanced Materials for Medical Devices



Pseudomonas aeruginosa PAO1 biofilm on glass treated with ciprofloxacin and stained with live/dead cell staining. Green fraction in the image represents alive bacteria and red dead cells.

HT screening for discovery of microtopographies that control bacterial attachment; Assessment of bacterial attachment to alginate hydrogels: potential use as drug delivery systems; Assessment of bacterial attachment to microparticles and Assessment of bacterial attachment to nanopatterned topographies

Dr Manuel Romero: Attachment of fluorescently labelled Pseudomonas aeruginosa has been assessed on the Topochip including 2,176 topounits. An optimised method for seeding and testing bacterial attachment on this platform has been established. With support from the Advanced Microscopy Unit (AMU) at the University of Nottingham, an automated method for imaging bacterial adhesion on micro patterned surfaces was implemented. Large differences have been observed in fluorescence associated to different micropatterns. A HT bacterial culture system with a luminescent strain and 96-well plates to polymerise alginates was developed and bacterial cell adherence was assessed and functionalised alginates with the lowest attachment were selected. Hydrogels are now being explored as potential bacteria-responsive platforms for controlling drug release. Using a 96-well plate assay with a luminescent bacterial strain on MPs, differences in bacterial attachment/killing were seen with different polymers and surfactants. Attachment of fluorescently labelled P. aeruginosa has been assessed on 20 different nanopatterns (nanopits) printed as spots on slide format (Prof. Nikolaj Gadegaard – University of Glasgow).

High throughput screening for discovery of immune-instructive biomaterials

Dr Blessing Mukonoweshuro/Dr Matthew Vassey: The protocol for macrophage seeding and intracellular cytokine immunostaining on the Topochip and ChemoTopo Chip has been optimised and HT screening has been carried out on these platforms to discover M1 (pro-inflammatory) and M2 (anti-inflammatory) promoting 'hit 'topographies and combinations of topography and chemistries. Data mining and analysis procedures are being developed and tested. Studies on the effect of microparticles (with different surface topographies) on macrophage polarisation are also underway with early results showing the influence of microparticle surface patterning on macrophage polarisation.

Engagement Activities

Summer Placements

2017 saw five undergraduates Shusha, James, Calvin, Aly and Nojus carry out summer placements at the University of Nottingham for eight weeks.

Outreach

On Saturday 17th June the Programme Grant team organised and a ran an event at Wonder 2017 (the University of Nottingham's community event). The Programme Grant event went really well and was called "The amazing material detective and the case of the superbug". 10 Post Docs and ~12 PhD students were involved on the day and over 350 people attended. Associate Prof Felicity Rose also led another event at Wonder regarding regenerative medicine in general.

Adam Dundas ran an event as part of the First Lego League on 6th January 2017 at the University of Nottingham.

Jamie Thompson was also involved in Science in the Park in March 2017 and was on the publicity team for Pint of Science 2016-17 and is a co-organiser for Pint of Science 2017-18.

Visits

Dr Ben Muir visited the University of Nottingham from CSIRO for four weeks from 24th April 2017. He carried out experiments using chromium as an antibody immobilisation arrays strategy.

Prof Dave Winkler came to the University of Nottingham for an extended stay early in 2017 and 2018 to work closely with Dr Paulius Mikulskis on the machine learning component of the programme and gave a talk in the School of Pharmacy.

Dr Paulius Mikulskis visited Prof Dave Winkler in Australia in November 2017 for an extended stay.

Yves Bayon from Medtronic visited the Programme Grant on 6th and 7th November 2017 and gave a talk in the School of Pharmacy.

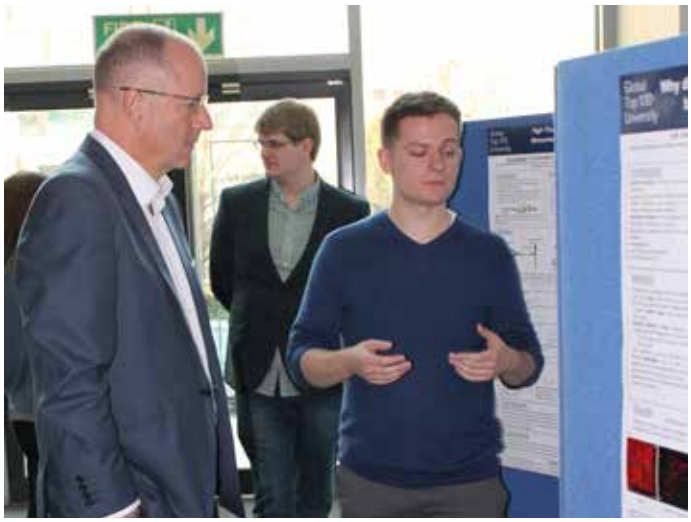
Alex Vasilevich from Maastricht visited the Programme Grant on 4th May 2017 to discuss the computational side of the Topochip work.

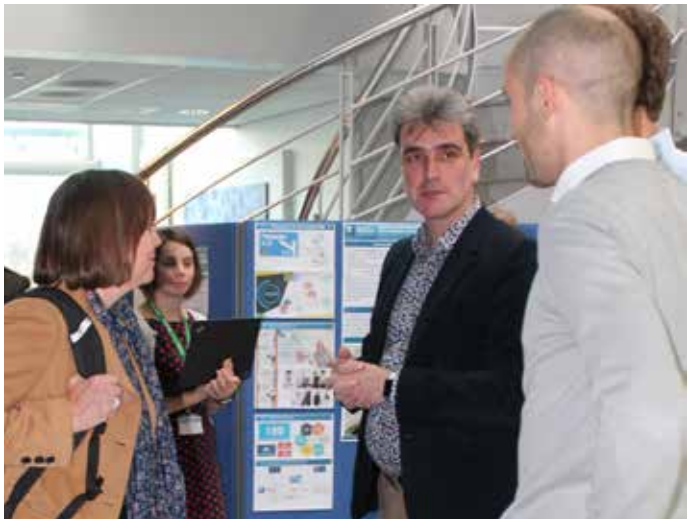
Ian Orme visited the Programme Grant in May after seeing Marta's image in a competition and getting in touch. Marta's image took first prize in the 'Weird and Wonderful' category of a national science photography competition organised by the EPSRC. Following this, Felicity and Morgan visited Ian at Colorado State University in November and a return visit is being planned for June 2018.

Sally Birse from EPSRC visited the Programme Grant on 22nd March, and Annette Bramley from the EPSRC visited in December 2016.

Sir Andrew Witty (Chancellor) and **Professor Shearer West** (Vice Chancellor) of The University of Nottingham met with members of the Programme Grant on 14th November 2017.

Stefan Oelmann visited the University of Nottingham from the Karlsruhe Institute of Technology (KIT) in January for a few weeks.





Conferences

Outgoing

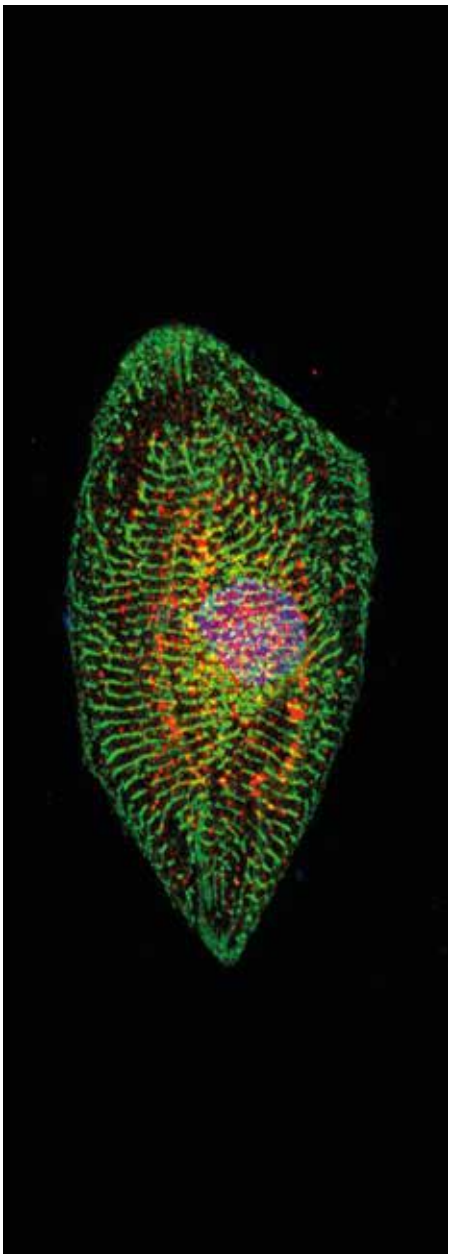
Society for Applied Microbiology -Antimicrobial Resistance: Meeting the Challenge- Novel Therapeutics and Drug Discovery	November 2017, London, Dr Nishant Singh presented.
Macro Group Medal Winners' Symposium	November 2017, Birmingham, Dr Nishant Singh and Prof Cameron Alexander presented.
3rd Biocide Toolbox Symposium	November 2017, University of Auckland, New Zealand, Auckland, Prof Paul Williams gave an Invited talk.
New Zealand Microbiology Society Annual Conference	November 2017, Auckland, New Zealand, Prof Paul Williams gave an Invited talk.
Colorado State University	November 2017, Associate Prof Felicity Rose and Prof Morgan Alexander gave an invited talk (following interest from Ian Orme after Marta's EPSRC photo competition success): 'Biomaterials for bone regeneration - from materials development to new biomaterials discovery'.
EPSRC HTHive17	November 2017, Glasgow, Prof Morgan Alexander and Prof Cameron Alexander attended.
Cell-Cell Communication in Bacteria 6 Conference	October 2017, American Society for Microbiology, Athens, Georgia, USA, Prof Paul Williams gave a Keynote talk.
Centro de Investigaciones Biológicas, Spanish National Research Council	October 2017, Madrid, Spain, Prof Paul Williams gave an Invited Seminar.
AVS	October 2017, Tampa, Prof Morgan Alexander gave a plenary lecture and Dr Britta Koch gave a contributed talk.
EPSRC ECR Workshop	October 2017, Manchester, Prof Cameron Alexander attended.
11th UK Mesenchymal Stem Cell (MSC)	September 2017, University of Chester, UK, Dr Mahi Amer gave an oral presentation.
Recent Appointees in Polymer Science	September 2017, Dr Amanda Pearce gave a talk and Prof Cameron Alexander presented.
Polymers for Advanced Technologies	September 2017, Dr Amanda Pearce gave a talk, Dr Nishant Singh gave a talk and presented a poster, Alessandra Travanut presented a poster and Dara O'Brien presented a poster and gave a talk and Prof Cameron Alexander was an organiser and Co-Chair.
SIMS Europe	September 2017, Krakow, Poland, Prof Morgan Alexander gave the talk "Why do bacteria stick to some surfaces and not others?"
Rutherford Appleton Laboratories	September 2017, Harwell Oxford, Prof Paul Williams gave an Invited Research Seminar.
UC San Diego	August 2017, Bioengineering, Jacobs School of Engineering, Institute of Engineering in Medicine, Prof Morgan Alexander gave a special seminar titled "Discovery of Bio-instructive Materials."
3rd Functional Polymeric Materials conference	July 2017, Rome, Italy, Prof Cameron Alexander was an Invited speaker.
Controlled Release Society	July 2017, Boston, USA, Dr Amanda Pearce gave a highlighted poster and Prof Cameron Alexander presented.

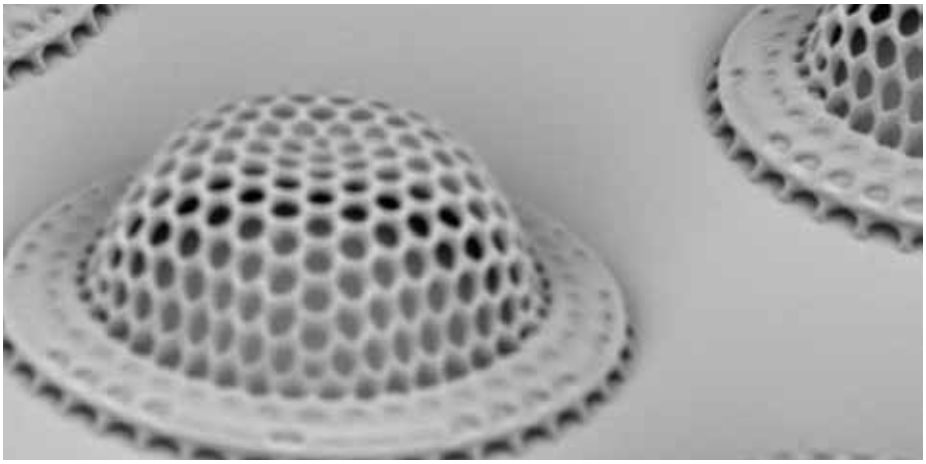
Conferences

FEBS Workshop - Biological Surfaces and Interfaces: Interface Dynamics	July 2017, Sant Feliu de Guixols, Spain, Dr Britta Koch.
Micro-engineering in medicine Workshop	July 2017, Harvard Boston, Prof Amir Ghaemmaghami presented.
TCES 2017: Tissue and Cell Engineering Society - 17th Annual Meeting	July 2017, Manchester Metropolitan University, Associate Prof Felicity Rose attended, Dr Mahi Amer gave an oral presentation and Dr Marta Alvarez Paino gave a poster presentation.
The United Kingdom Society for Biomaterials	June 2017, Prof Morgan Alexander gave the talk, "Bio-instructive materials discovery."
TERMIS (Tissue engineering and regenerative medicine international society)	June 2017, Davos, Prof Morgan Alexander, Associate Prof Felicity Rose and Amir Ghaemmaghami presented and Marta Alvarez Paino presented a poster.
Biomaterials Congress BIOMAT	June 2017, France, Prof Morgan Alexander gave a talk.
FEMS Congress	June 2017, Valencia, Spain, Prof Paul Williams was Session Organizer, Chair and gave an Invited Talk.
Macrogroup YRM	June 2017, Edinburgh, Scotland, Dr Amanda Pearce, Valentina Crucitti and Dara O'Brien gave poster presentations and Prof Cameron Alexander presented.
UKSB 2017: The United Kingdom Society for Biomaterials	June 2017, Loughborough, Dr Marta Alvarez Paino and Dr Mahi Amer gave poster presentations and both came joint runners up.
Center for Research in Molecular Medicine and Chronic Diseases (CiMUS)	June 2017, Prof Cameron Alexander gave a talk at the University of Santiago de Compostela, Spain.
UK PharmSci	June 2017, Prof Cameron Alexander gave a talk on "Exploiting biological responses with polymer therapeutics" at the University of Hertfordshire, Hatfield.
Broad Institute	May 2017, Prof Morgan Alexander gave the talk "Discovery of Bio-instructive Materials".
European Congress 3D Printing in Science	May 2017, Hanover, Germany, Prof Amir Ghaemmaghami presented.
EPSRC Targeted Therapeutics Workshop	May 2017, Bristol, Prof Cameron Alexander attended.
PyData	May 2017, London, Dr Paulius Mikulskis attended.
KIT	April-May 2017, Alessandra Travanut visited Prof Mike Meier. She has also done a German course.
The High Polymer Research Group annual meeting	April 2017, Pott Shrigley, Cheshire, Prof Cameron Alexander presented.
European Nanomedicine Meeting	April 2017, King's College, London, Prof Cameron Alexander was an Invited speaker.
BSMB Spring Meeting, Matrix Proteoglycans	April 2017, Oxford University, Jamie Thompson presented.
Bristol Synthesis Meeting	April 2017, Dara O'Brien presented.
The British Society for Nanomedicine's European Nanomedicine Meeting	April 2017, London, UK, Prof Cameron Alexander and Dr Amanda Pearce presented.

Outgoing

KIT	February 2017, Prof Morgan Alexander gave a talk.
University of Birmingham	February 2017, Prof Cameron Alexander gace the invited lecture: “Synthetic polymers as probes for biology” at the University of Birmingham, Department of Chemistry.
50th Annual Meeting on ‘Modern Aspects of Stereochemistry’	January 2017, Dara O’Brien attended.
Frontiers in Green Materials	December 2016, Dara O’Brien attended.

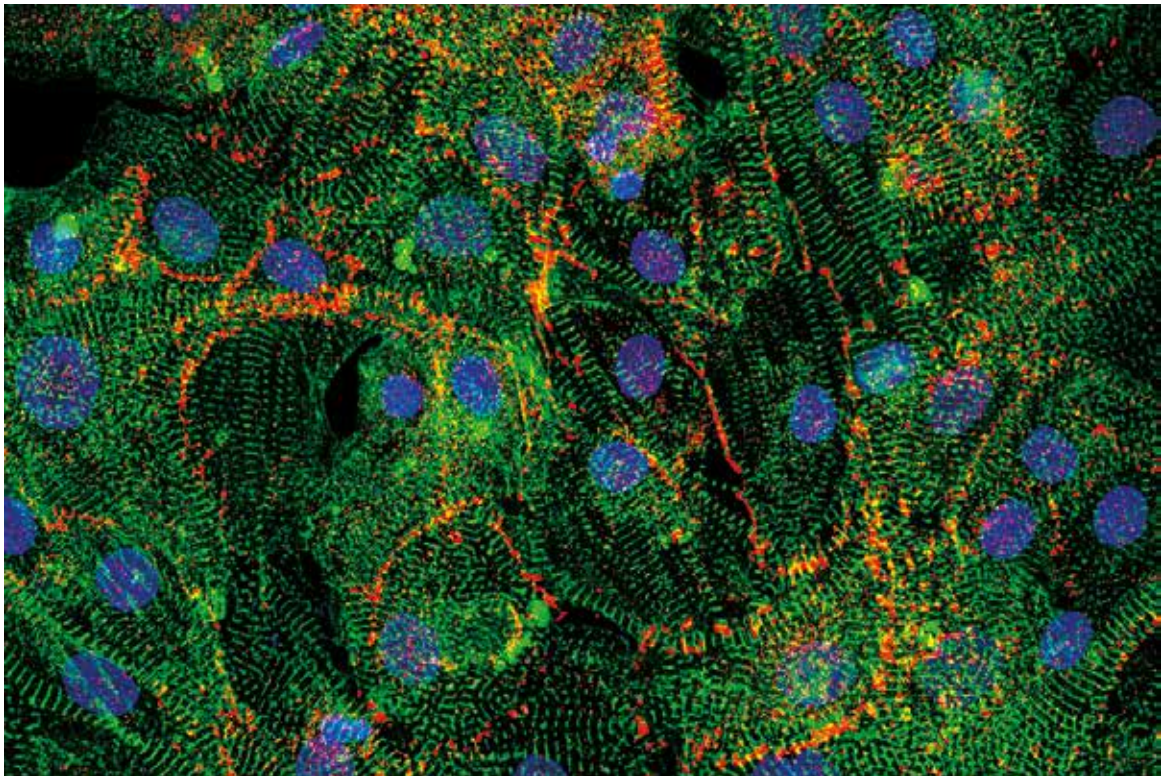




Incoming

The Chancellor of the University of Nottingham's visit	November 2017, University of Nottingham, Dr Britta Koch gave a ToF SIMS demonstration and Adam Dundas, Jordan Thorpe and Dara O'Brien presented a poster to the Chancellor of the University of Nottingham.
The Vice-Chancellor of the University of Nottingham's visit	November 2017, University of Nottingham, Adam Dundas, Dara O'Brien and Laurence Burroughs presented a poster to the Vice-Chancellor of the University of Nottingham.
Translational Talks	As part of our series of clinical talks we have had Prof Poulam Patel (Nottingham), Dr David Adlam (Leicester), Simon Parsons (Nottingham), Dave Hampton (CamStent), Catrin Rutland (School of Veterinary Medicine and Science, Nottingham.
NC3Rs Conference	September 2017, Nottingham, East Midlands Conference Centre, Prof Cameron Alexander attended.
Cancer Research Nottingham	Sept 2017, University of Nottingham, Dr Amanda Pearce gave an Invited talk on Chemistries for 'Self-Assembling Polymer-Drug Conjugates'.
Joint meeting with the Glasgow Programme Grant	July 2017, University of Nottingham, many PG members attended the joint PG meeting.
School of Pharmacy Conference	July 2017, University of Nottingham, Dr Mahi Amer gave an oral presentation and Dr Marta Alvarez Paino gave a poster presentation.
Technology Touching Life Workshop	June 2017, Nottingham, Prof Cameron Alexander attended.
BHF Regenerative Medicine Centres Event	June 2017, University of Nottingham, Prof Morgan Alexander gave a talk and Jordan Thorpe presented a poster.
CDT/Nanofar workshop/training week	April 2017, Nottingham, Dr Amanda Pearce gave an invited talk.
Cyclops Grand Challenge Workshop	March 2017, Nottingham Conference Centre, Prof Cameron Alexander attended.
Inaugural Biomaterials Discovery Workshop	January 2017, University of Nottingham, most PG members attended, Post Docs presented posters and some academics chaired sessions.

Awards



- EPSRC 3D OrbiSIMS: Label free chemical imaging of materials, cells and tissues. £2.5m, 2017 for 4 years (EP/P029868/1) PI Morgan Alexander.
- EPSRC: Radiotherapy activated materials for enhanced cancer treatments. £539,154, EP/N03371X/1.
- Future Vaccine Manufacturing Hub: Advancing the manufacture and deployment of cost effective vaccines. 2017-2021, £9,947,570. Cameron Alexander (Co-I), ~£300k to Nottingham (EP/R013764/1).
- EPSRC: Experiencing the micro-world – a cell's perspective. Amanda Wright (PI), Cathy Merry and Cameron Alexander (Co-I). 2018 - 2021, £752,573.
- BBSRC National Biofilms Innovation Centre Innovative Knowledge Centre. £15.6m, Oct 2017 for 5 years (Miguel Camera et al BB/R012415/1).
- H2020 grant 'Personalised Integrated Biomaterials Risk Assessment (PanBioRA)'. Value: 7,944,786 Euros. Start date: January 2018. Duration: 4 years. Amir Ghaemmaghami.
- 10 months additional funds through MRC CiC for a PDRA to expand on some of our polymer hits, start 2018, £70k, Amir Ghaemmaghami and Blessing Mukonoweshuro.
- Morgan Alexander was awarded the British Vacuum 2017 Senior Prize at the AVS Biointerfaces Plenary: Engineering a Paradigm Shift in Control of Microbes and Fouling. The past president of the BVC, Alex Shard, presented the John Yarwood Medal to Morgan before he delivered his Plenary Lecture.

- Martyn Davies has been appointed as a Commander of the Order of the British Empire (CBE) in Her Majesty's 2018 New Year's Honours List. This award is in recognition of Martyn's contribution to science and his ground-breaking achievements in pharmaceutical research and drug development.
- Camstent have received a CE mark for the catheter developed with biomaterials from the University of Nottingham as a coating to prevent infection and reduce associated costs.
- EPSRC Thematic DTP, Felicity Rose.
- Enabling Next Generation Additive Manufacturing for Pharma and related industries: new major programme funded by EPSRC, £5.9M, Richard Hague and Clive Roberts.
- The winning team in the PG's Ideas Generation event, November 2017, was: Simon Haas, Qin Hu, Blessing Mukonoweshuro, Joris Meurs, Alessandra Travanut and Charlotte Henshaw.
- Marta Alvarez Paino gained 1st prize in the 'Weird and wonderful' category of the EPSRC Science photo competition 2017.
- Marta Alvarez Paino received the School of Pharmacy conference 2017, 1st poster prize.
- Marta Alvarez Paino and Mahi Amer received the UK Biomaterials Society conference, 2nd poster prize.
- Marta Alvarez Paino received the International University Menendez-Pelayo Doctoral Prize 2017.
- Arsalan Latif gained second place in 'The Art in Science' Post-graduate researcher image competition, as part of the Creative Reactions project at the Pint of Science festival.
- Britta Koch received the Early Career Researcher award of the Biomaterial Interface Division at the AVS 64th International Symposium in Tampa, Florida.

Relevant Publications from the second year

Publications aligned with the theme of the programme grant:

1. Alexander M.R and Williams P. Water contact angle is not a good predictor of biological responses to materials. Biointerphases, 2017, 12(2).

2. Amer M.H., Rose F.R.A.J., Shakesheff K.M., Modo M. and White L.J. Translational considerations in injectable cell-based therapeutics for neurological applications: concepts, progress and challenges. npj Regenerative Medicine, 2017, 2 (23)/1-23/13.

3. Amer M.H., Rose F.R.A.J., White L.J. and Shakesheff K.M. A Detailed Assessment of Varying Ejection Rate on Delivery Efficiency of Mesenchymal Stem Cells Using Narrow-Bore Needles. **Stem Cells Translational Medicine**, 2016, 5(3), 366-378.

4. Barr H.L., Cámara M., Barrett D., Williams P., Forrester D., Smyth A., Honeybourne D., Whitehouse J., Nash E., Dewar J., Knox A. and Fogarty A.W. Weight gain during acute treatment of an initial pulmonary exacerbation is associated with a longer interval to the next exacerbation in adults with cystic fibrosis. **ERJ Open Res**, 2017, 25;3(3). pii: 00057-2017.

5. Blanco-Fernandez B., Concheiro A., Makwana H., Fernandez-Trillo F., Alexander C. and Alvarez-Lorenzo C. Dually sensitive dextran-based micelles for methotrexate delivery. **RSC Advances,** 2017, 7, 14448-14460.

6. Brazzale C., Mastrotto F., Moody P., Watson P.D., Balasso A., Malfanti A., Mantovani G., Caliceti P., Alexander C., Jones A. T. and Salmaso S. Control of targeting ligand display by pH-responsive polymers on gold nanoparticle s mediates selective entry into cancer cells. **Nanoscale**, 2017, 9, 11137-11147.

7. Cha B.H., Shin S.R., Leijten J., Li Y.C., Singh S., Liu J.C., Annabi N., Abdi R., Dokmeci M.R., Vrana N.E., Ghaemmaghami A.M. and Khademhosseini A. Integrin-Mediated Interactions Control Macrophage Polarization in 3D Hydrogels. **Advanced Healthcare Materials**, 2017, 6(21).

8. Clark E.A., Alexander M.R., Irvine D.J., Roberts C.J., Wallace M.J., Sharpe S., Yoo J., Hague R.J.M., Tuck C.J. and Wildman R.D. 3D Printing of Tablets Using Inkjet with UV Photoinitiation. **International Journal of Pharmaceutics**, 2017, 529(1–2), 523-530.

9. Devescovi G., Kojic M., Covaceuszach S., Cámara M., Williams P., Bertani I., Subramoni S. and Venturi V. Negative Regulation of Violacein Biosynthesis in Chromobacterium violaceum. **Front Microbiol**, 2017, 7;8:349.

10. Dollinger C., Ciftci S., Knopf-Marques H., Guner R., Ghaemmaghami A.M., Debry C., Barthès J. and Vrana N.E. Incorporation of Resident Macrophages in Engineered Tissues: Multiple Cell Type Response to Microenvironment Controlled Macrophage-laden Gelatin Hydrogels. **Journal of Tissue Engineering and Regenerative Medicine**, 2017.

11. Duncan G., Firth K., George V., Staniforth A., Smith G. and Denning C. Drug-mediated shortening of action potentials in LQTS hiPSC-cardiomyocytes. **Stem Cells & Development**, 2017, 1;26(23):1695-1705.

12. England R.M., Hare J.I., Barnes J., Wilson J., Smith A., Strittmatter N., Kemmitt P.D., Waring M.J., Barry S.T., Alexander C. and Ashford M.B. Tumour regression and improved gastrointestinal tolerability from controlled release of SN-38 from novel polyoxazoline-modified dendrimers. **Journal of Controlled Release: Official Journal of the Controlled Release Society**, 2017, 247, 73-85.

13. Eo J., Shin J.Y., Leijten J., Jeon O., Camci-Unal G., Dikina A.D., Brinegar K., Ghaemmaghami A.M., Alsberg E. and Khademhosseini A. High-throughput approaches for screening and analysis of cell behaviors. **Biomaterials,** 2017, 153:85-101.

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16. He Y., Tuck C.J., Prina E., Kilsby S., Christie S.D.R., Edmondson S., Hague R.J.M., Rose F.R.A.J. and Wildman R.D. A new photocrosslinkable polycaprolactone-based ink for three-dimensional inkjet printing. **Journal of Biomedical Materials Research Part B-Applied Biomaterials**, 2017, 105(6), 1645-1657.

17. Heeb S., Càmara M., Filloux A. and Williams P. Professor Dieter Haas (1945-2017). **FEMS Microbiol Rev**, 2017, 14.

18. Htwe S.S., Cha B.H., Yue K., Khademhosseini A., Knox A.J. and Ghaemmaghami A.M. Role of Rho-Associated Coiled-Coil Forming Kinase Isoforms in Regulation of Stiffness-Induced Myofibroblast Differentiation in Lung Fibrosis. **American Journal of Respiratory Cell and Molecular Biology**, 2017, 56(6), 772-783.

19. Huertas-Rosales Ó., Romero M., Heeb S., Espinosa-Urgel M., Cámara M. and Ramos-González M.I. The Pseudomonas putida CsrA/RsmA homologues negatively affect c-di-GMP pools and biofilm formation through the GGDEF/EAL response regulator CfcR. **Environmental Microbiology**, 19(9):3551-3566.

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21. Kyobula M., Adedeji A., Alexander M.R., Saleh E., Wildman R., Ashcroft I., Gellert P.R. and Roberts C.J. 3D inkjet printing of tablets exploiting bespoke complex geometries for controlled and tuneable drug release. **Journal of Controlled Release: Official Journal of the Controlled Release Society**, 2017, 261, 207-215.

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25. Mikulskis P., Hook A., Dundas A., Irvine D., Sanni O., Anderson D., Langer R., Alexander M., Williams P. and Winkler D. Prediction of Broad-spectrum Pathogen Attachment to Coating Materials for Biomedical Devices. **ACS Applied Materials & Interfaces**, 2017, am-2017-141975.R1

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The Year Ahead

- Prof Dave Winkler going to visit the University of Nottingham in June 2018 to work closely with Dr Paulius Mikulskis on the machine learning component of the Programme Grant.
- Professor Paul Evans and Dr Cecile Perrault from the University of Sheffield are giving the talk “Stents and Arterial Mechanobiology” on 13th June 2018.
- David Baguley and Anand Kasbekar are giving a talk to the Programme Grant on 14th June 2018, talking from an Otology (ear surgery, Anand) and Audiology (David) perspective respectively.
- More summer placement students will be recruited to work on the project for eight weeks each.
- The final Centre for Doctoral Training student and PhD student will be recruited to the project.
- Biomaterials Discovery workshop has been established and will run annually at the University of Nottingham.

Key Individuals

Investigators

Morgan Alexander

Principal Investigator and RC1 lead.
Professor of Biomedical Surfaces, School of Pharmacy, Advanced Materials and Healthcare Technology.

Cameron Alexander

Co-Investigator and RC2 lead.
Professor of Polymer Therapeutics, School of Pharmacy, Head of Molecular Therapeutics and Formulation Division.

Felicity Rose

Co-Investigator and RC3 lead.
Associate Professor and Reader in Tissue Engineering, School of Pharmacy, Regenerative Medicine and Cellular Therapies Division.

Amir Ghaemmaghami

Co-Investigator and RC4 lead.
Professor of Immunology & Immuno-bioengineering and Course Director for MSc in Immunology & Allergy, Faculty of Medicine & Health Sciences.

Martyn Davies

Co-Investigator – Martyn is mainly involved in RC4.
Emeritus Professor of Biomedical Surface Chemistry, School of Pharmacy, Advanced Materials and Healthcare Technologies Division.

Richard Hague

Co-Investigator - Richard is involved mainly in RC1.
Professor of Innovative Manufacturing, Director - EPSRC Centre for Additive Manufacturing, Faculty of Engineering.

Investigators

Kevin Shakesheff

Co-Investigator on this grant, Kevin is involved mainly in RC3.
Pro-Vice Chancellor of the Faculty of Science and Professor of Advanced Drug Delivery and Tissue Engineering, School of Pharmacy, Regenerative Medicine and Cellular Therapies.

Ricky Wildman

Co-Investigator on this grant, Ricky is involved mainly in RC1 and 3.
Professor of Multiphase Flow and Mechanics, Faculty of Engineering.

Derek Irvine

Co-Investigator on this grant, Derek is involved in RC1, 2 and 3.
Professor of Chemistry and Chemical Engineering, Faculty of Engineering.

Anna Grabowska

Co-Investigator on this grant, Anna is involved mainly in RC2.
Associate Professor, Faculty of Medicine & Health Sciences.

Chris Denning

Co-Investigator on this grant, Chris is involved mainly in RC3.
Professor; Head of Department of Stem Cell Biology, Faculty of Medicine & Health Sciences.

Paul Williams

Co-Investigator on this grant, Paul is involved mainly in RC4.
Professor of Molecular Microbiology, Faculty of Medicine & Health Sciences.

Investigators

Steve Howdle

Steve is involved mainly in RC2.
Professor of Chemistry, Faculty of Science.

Christopher Tuck

Christopher is involved mainly in RC1.
Professor of Materials Engineering, Faculty of Engineering.

Josephine Bunch

Josephine is mainly involved in RC1. Professor Josephine Bunch is a Principal Scientist and Co-Director of the National Centre of Excellence in Mass Spectrometry Imaging (NiCE-MSI) at NPL and Chair of Biomolecular Mass Spectrometry at Imperial College London.

Cathy Merry

Cathy is mainly involved in RC3.
Associate Professor in Stem Cell Glycobiology, Faculty of Medicine & Health Sciences.

Phil Williams

Phil is mainly involved in RC1.
Professor of Biophysics, Director of Research and Knowledge Exchange, Faculty of Science.

Robert Stockman

Robert is mainly involved in RC2.
Professor of Organic Chemistry, Faculty of Science.

Investigators

Hyun Kim

Hyun is mainly involved in RC1.
Assistant Professor in Analytical Bioscience, Faculty of Science.

Project Manager

Elizabeth Hufton

Project Manager.
Elizabeth joined the project in 2016 as the Project Manager.

Post Docs

Laurence Burroughs

PostDoctoral Research Fellow: School of Pharmacy, Advanced Materials and Healthcare Technologies Division. Laurence joined the project in 2018 working on combinatorial screening of biomaterial surface chemistry and topography in RC1.

Adam Dundas

PostDoctoral Research Fellow, Faculty of Engineering.
Adam joined the project in 2017 working on making polymer particles from microfluidics in RC1.

Paulius Mikulskis

PostDoctoral Research Fellow: School of Pharmacy, Advanced Materials and Healthcare Technologies Division.
Paulius joined the project in 2015 working on Determining Biomaterial Design Rules in RC1.

Amanda Pearce

PostDoctoral Research Fellow: School of Pharmacy, Molecular Therapeutics and Formulation Division.
Amanda joined the project in 2016 working on Chemistries for Self-Assembling Polymer-Drug Nanoparticles in RC2.

Post Docs

Nishant Singh

PostDoctoral Research Fellow: School of Pharmacy, Molecular Therapeutics and Formulation Division.
Nishant joined the project in 2017 working on polymers for drug delivery in RC2.

Marta Alvarez

PostDoctoral Research Fellow: School of Pharmacy, Regenerative Medicine and Cellular Therapies Division. Marta joined the project in 2016 working on polymer microparticles for regenerative medicine in RC3.

Aishah Nasir

PostDoctoral Research Fellow: Faculty of Medicine & Health Sciences, cardiomyocyte maturation.
Aishah joined the project in 2018 working cardiomyocyte maturation in RC3.

Mahetab Amer

PostDoctoral Research Fellow: School of Pharmacy, Stem Cell Biology. Mahi joined the project in 2017 working on differentiation of human mesenchymal stem cells to bone in RC3.

Matthew Vassey

PostDoctoral Research Fellow: Immunology and Biomaterials, Faculty of Medicine & Health Sciences.
Blessing joined the project in 2017 working on immunology in RC4.

Manuel Romero

PostDoctoral Research Fellow: Faculty of Medicine & Health Sciences. Manuel joined the project in 2016 working on microbiology in RC4.

Post Docs

Leanne Fisher

PostDoctoral Research Fellow: School of Life Sciences
Leanne joined the project in 2018 working on immunology and immuno-bioengineering in RC4.

Qin Hu

PostDoctoral Research Fellow, Faculty of Engineering.
Qin joined the project in 2017 working on two photon polymerization in RC1. This is a joint post between the Additive Manufacturing Programme Grant and the Next Generation Biomaterials Discovery Programme Grant.

PhDs

Jordan Thorpe

PhD Student, Faculty of Medicine & Health Sciences.
Jordan joined the project in 2015 working on cardiomyocyte maturation.

Arsalan Latif

PhD Student, Medicine & Health Sciences.
Arsalan joined the project in 2016 working on Developing immune instructive niches to promote healing and suppress fibrosis, mainly associated with RC4.

Kiril Kalenderski

PhD Student, Medicine & Health Sciences.
Kiril joined the project in 2016 working on Exploiting 3D synthetic bacterial communities to investigate virulence and antibiotic resistance, mainly associated with RC4.

Francesco Pappalardo

PhD Student, School of Pharmacy.
Francesco joined the project in 2016 working on Novel polymer microparticles and their influence on mesenchymal stem cell behaviour, mainly associated with RC3.

PhDs

Alessandra Travanut

PhD Student, School of Pharmacy.
Alessandra joined the project in 2016 working on Multi-Component Polymerization (MCP) Reactions for Biomedical Materials, mainly associated with RC2.

Dara O'Brien

PhD Student, School of Chemistry.
Dara joined the project in 2016 working on New and renewably sourced sustainable functional degradable polymers, mainly associated with RC2.

Valentina Cuzzucoli Crucitti

PhD Student, Faculty of Engineering.
Valentina joined the project in 2016 working on Continuous Sustainable Synthesis of Polymeric Resins for use in the Construction of 3D structures, mainly associated with RC2.

Joris Meurs

PhD student, School of Pharmacy and the National Physical Laboratory. Joris joined the project in 2017 working on developing mass spectrometry strategies for examination of cellular responses in media and on complex surfaces, mainly associated with RC1.

Eduardo Pernaut-Leza

PhD student, Medicine and Health Sciences.
Eduardo joined the project in 2017 working on screening combinatorial materials microarrays to identify inducers of epithelial-mesenchymal transition, mainly associated with RC2.

Jamie Thompson

PhD student, Medicine and Health Sciences.
Jamie joined the project in 2017 working on matrix-inspired biomaterials for cell phenotype control, mainly associated with RC3.

PhDs

Charlotte Henshaw

PhD student, School of Pharmacy.
Charlotte joined the project in 2017 working on Micropipette manipulation for nanoparticle production and characterization in biomaterials discovery, mainly associated with RC1.

Alice Konta

PhD student, Faculty of Engineering.
Alice joined the project in 2017 working on biofunctional materials development for multiphoton fabrication of nanostructures, mainly associated with RC2.

Leonardo Contreas

PhD student, School of Pharmacy.
Leonardo joined the project in 2018 working on computational approaches to determining biomaterial design rules, mainly associated with RC1.

Alumni

Benoit Couturaud

Previously a PostDoctoral Research Fellow: School of Pharmacy, Molecular Therapeutics and Formulation Division working on polymers for drug delivery in RC2. We said farewell to Benoit in August 2016, who has taken up a Marie Curie Fellowship at The University of Warwick with Professor Rachel O'Reilly and Kristopher Thurecht (The University of Queensland). His replacement is aiming to start in 2017.

Simon Haas

Previously a PostDoctoral Research Fellow, Faculty of Engineering, working on making polymer particles from microfluidics in RC1. We said farewell to Simon in 2017 and he is now working for Promethean Particles. Adam Dundas has now joined the Programme Grant.

Alumuni

Karl Firth

Previously a PostDoctoral Research Fellow: Faculty of Medicine & Health Sciences, working on cardiomyocyte maturation in RC3. We said farewell to Karl in 2017 and he is now working at Clyde Biosciences. Aishah Nasir has now joined the Programme Grant.

Britta Koch

Previously a PostDoctoral Research Fellow in the School of Pharmacy, working on combinatorial screening of biomaterial surface chemistry and topography in RC1. We said farewell to Britta at the end of January 2018, and she is looking for a position in Germany.

Blessing Mukonoweshuro

Previously a PostDoctoral Research Fellow: Immunology and Biomaterials, Faculty of Medicine & Health Sciences, working on immunology in RC4. We said farewell to Blessing in 2018 and he is now working as an Intellectual Property and Innovation Officer at Quadram Institute in Norwich.

Linked students

Elisa Tarsitano:

Linked to the CDT in Regenerative Medicine: Bioprinting using cell-laden hydrogel fibres with defined microenvironment

Nicholas Poulson:

Linked to the CDT in Regenerative Medicine: Studying and controlling cell-cell and cell-material interactions.

Akosua Anane-Adjei:

Linked to the CDT in Advanced Therapeutics and Nanomedicines.

Catherine Vasey:

Linked to the CDT in Advanced Therapeutics and Nanomedicine.

Christopher Strong:

Linked to the CDT in Additive Manufacturing and 3D Printing.

Training

- Gill Shuttleworth and Raman Minhas delivered a course on IP, licensing, corporate partnerships and research collaboration to the PG on 6th April 2017. Gill Shuttleworth is the IP Commercialisation Manager at UoN and Raman Minhas is from Corporate Partnerships, Healthcare at UoN. They held a workshop with the Post Docs and PhD students on the Programme Grant. The training session introduced them to Gill and Raman and explained how they can help. There was a presentation from Gill and from Raman, followed by a Q&A session.

- Post Docs and PhD students from the PG also attended training from an external trainer Simon Hoffman on GXP (Good Manufacturing/Laboratory Practice) on 25th September 2017. This was following comments from the External Advisory Board, to advance the understanding of translational processes from academia to industry/clinic in the context of the Programme Grant. Simon discussed technology transfer using case studies to demonstrate this. Simon has also provided material after the event and offered to help as required again further down the line. One PhD student said: "I was going to send an email just saying how much I enjoyed today. I thought it was incredibly useful and Simon was very funny and engaging, which made some of the heavier parts very manageable!"

- We have also established Translational Talks from clinicians and industrialists for all PG members to attend. As part of this series we have hosted talks from Prof Poulam Patel (Nottingham), Dr David Adlam (Leicester), Simon Parsons (Nottingham) and Dave Hampton (CamStent).

- Ideas generation: Post Docs and PhD students from the PG presented their scientific ideas to our panel of experts on November 15th, as the final part of an Ideas Generation process which was facilitated by Prof Simon Mosey and Dr Andy Wells. Ingenuity Workshops on 26th October and 15th November allowed the Post Docs and PhD students to generate ideas relating to the PG. They divided into teams, generated their ideas and gave their presentations. The Expert Panel judged the ideas presented based on: scientific creativity and novelty, presentation skills, project delivery and consideration of translational route. The panel members were: Morgan Alexander, Amir Ghaemmaghami, Ricky Wildman (The University of Nottingham), Rachel O'Reilly (The University of Warwick), David Farrar (Xiros) and Rob Quirk (Locate Therapeutics). Of the 3 teams of Post Docs and PhD students, the panel selected Arsalan Latif, Blessing Mukonoweshuro, Qin Hu, Simon Haas, Joris Meurs, Elisa Tarsitano, Charlotte Henshaw and Alessandra Travanut as the winning team. Their prizes were locally produced drinks, cheeses and biscuits. We had a drinks and nibbles reception to congratulate and thank everyone for taking part.

Biomaterials Discovery Programme Grant at a Glance

Timeline

We are at the half way point now of the Programme Grant.

2015-16	2016-17	2017-18	2018-19	2019-2020

Funding

Heading	Project Budget	Actual to Date	Budget Balance
Staff costs	1,961,808	792,465	1,169,343
Travel and Subsistence	315,162	59,425	255,737
Other Costs*	1,394,065	418,573	937,042
Overheads	3,036,416	1,524,573	1,512,933
University of Nottingham contribution	(1,341,491)	(848,279)	(486,304)
Total	5,365,960	1,946,757	3,388,750

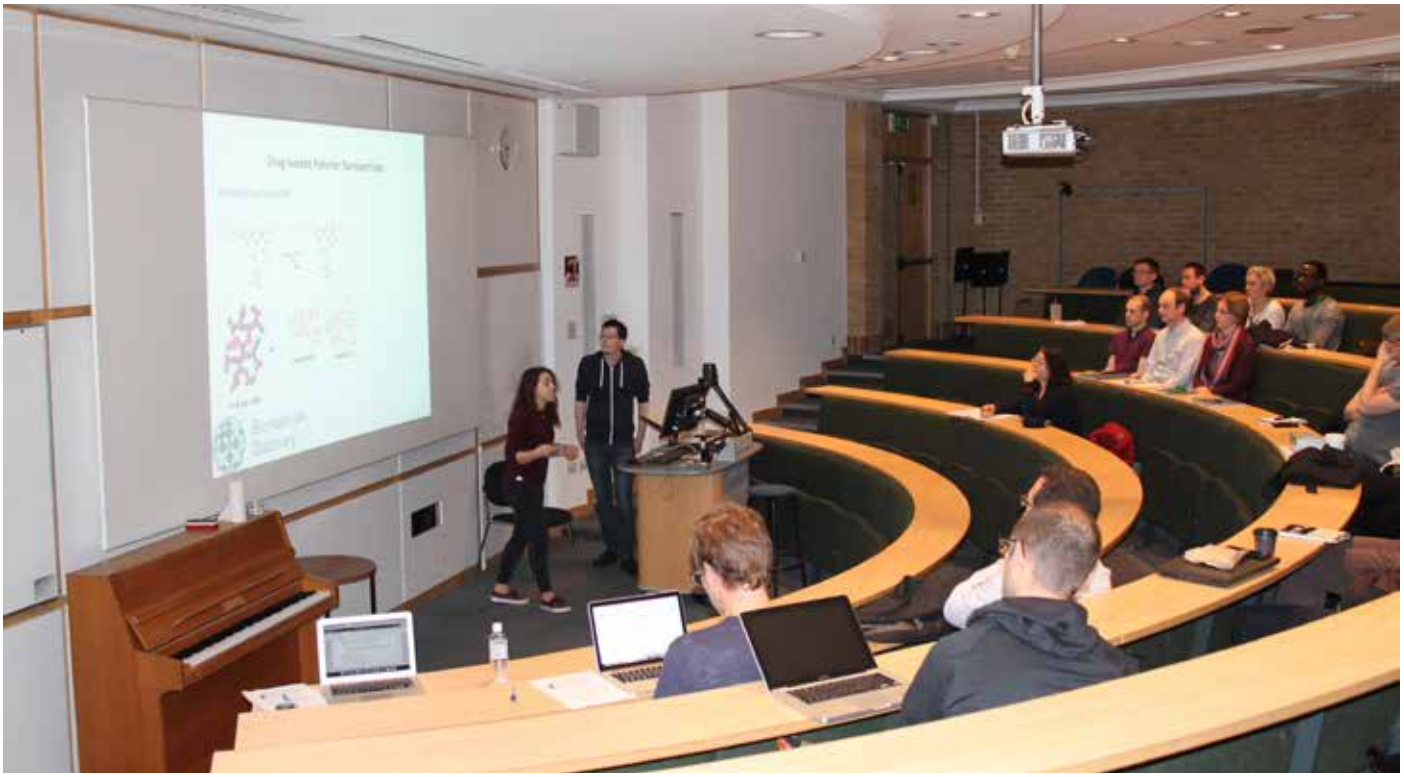
*** This covers any directly incurred costs within the grant.**

Key Data

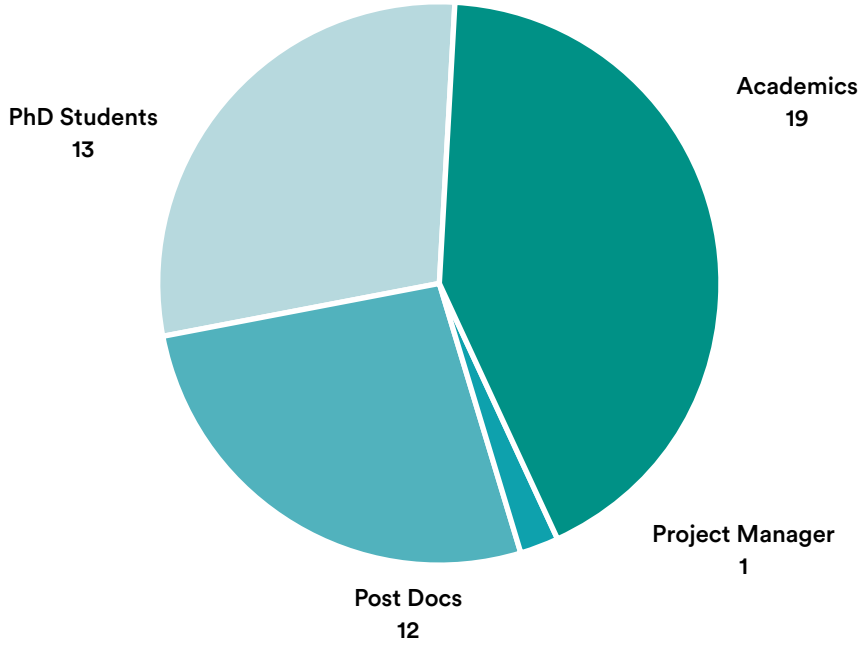
We have been involved in **46** publications, given **28** talks and presented **29** posters in 2016-17.

Collaborators

Dan Anderson (Massachusetts Institute of Technology), Jan de Boer (Maastricht University), Dave Winkler (La Trobe, Monash and CSIRO) and Dave Needham (the University of Southern Denmark).



Our People



External Advisory Board

The External Advisory Board members include:

- Dave Grainger (Utah) – Chair
- Karen Davie (EPSRC representative)
- Brian Henry (Pfizer)
- Joe De Sousa (AstraZeneca)
- Mark Bradley (Edinburgh)
- Rachel O'Reilly (Birmingham)
- David Farrar (Xiros)

Contact

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Gill Shuttleworth
☎ +44 (0)115 82 32189
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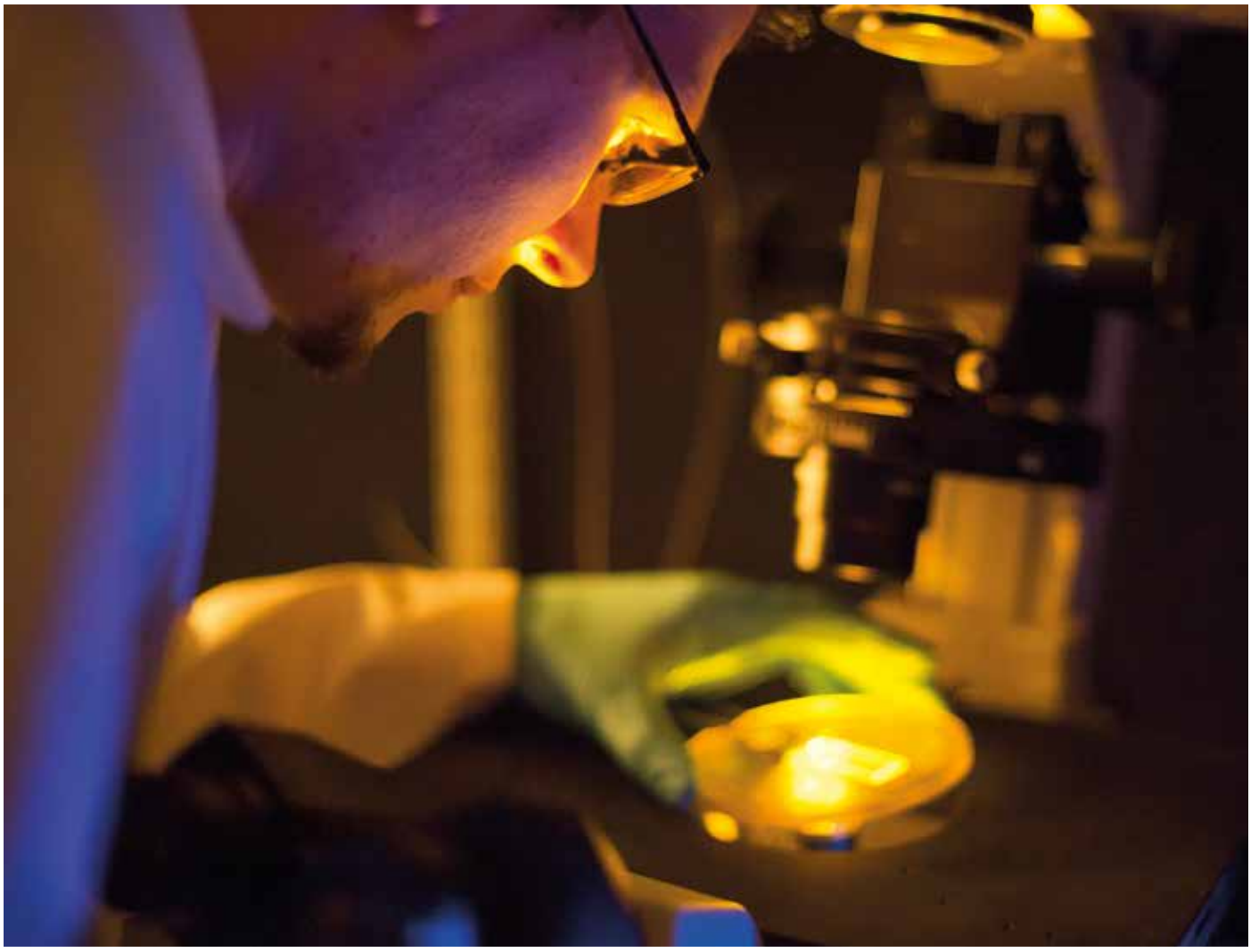


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